SEVENTH TECHNICAL PROGRESS REPORT
For the Period October, November, December 1966

DEVELOPMENT OF TECHNOLOGICAL CONCEPTS LEADING TO THE BENEFICIAL USE OF LUNAR MAGMA PRODUCTS

Contract NAS 7-358

Principal Investigator, E. Azmon, Ph.D.

ACTIVITIES LAST QUARTER

During the last quarter we acquired the large Carl-Zeiss petrographic photomicroscope (35 mm plus automatic exposure control). This gives us improved optical resolution and allows more refined petrographic examination.

The effort concentrated on the analysis of gabbro and serpentine, on the completion of analysis of an artificial olivine, and on the extension of some high pressure data down to one atmosphere. We conducted a total of 53 new experiments to determine the solid-liquid phase transformations which bring the total number of determinations to date to 649. A sufficient backlog of partly analyzed experiments is available to assure a continuous supply of samples for petrographic and x-ray analyses.

Another major analytical instrument became available to us during the second half of this quarter when the (Norair Division of Northrop) acquired an Electron Probe attachment to their Hitachi Electron microscope. Techniques were developed to prepare samples for optimum results and we hope to begin accumulating reliable data in the next quarter.

NEW DATA

Olivine - The determination and analyses of melting of fayalite (the iron end member of the olivine series) were carried up to 40 kilobars. The enclosed summarizing document has been prepared for publication. L. C. Hsu, one of the students working on our contract did most of the work on the fayalite, hence, we would like to publish the results under his name, giving proper acknowledgement to this contractual support. L. C. Hsu was granted his Ph.D. degree in geology from UCLA last summer and is now with the Pennsylvania State University.

Gabbro - Pressure-temperature experiments with gabbro showed that ex-

posing the sample to proper P-T combinations prior to quenching produces one of five quench phases: (1) unaltered original rock; (2) recrystallization of original crystals; (3) quench crystallization from melt; (4) glass; (5) any of the above in a vesicular matrix. It was assumed that if a single sample is prepared so that a thermal gradient would exist from end to end, it might be possible to obtain all five phases in one experiment on the one sample. Such an experiment would have served to examine the phase transitions. The actual determination showed that due to pressure dependence, there were P-T combinations at which one phase or another could not exist. Figure 1 shows these relations in a genesis diagram. (A genesis diagram shows the end products of the process. This is different from a phase diagram that shows the phases that coexist while a set of P-T conditions prevail.)

Serpentine - Pressure-temperature experiments with serpentine were completed up to 45 kilobars.

Petrographic Properties of Cast and Formed Geometric Shapes - The data collected in the past two years were used as a basis for casting and forming geometric shapes of some rocks (Figure 2). Most of this effort was concentrated on controlling the shapes at temperatures slightly below and slightly above the melting ranges. Four different containers were examined for holding the rock melt: boron-nitride, graphite, talc, and pyrophyllite. The graphite appears to give the best service and the petrographic determinations will be mostly based on melts prepared in graphite.

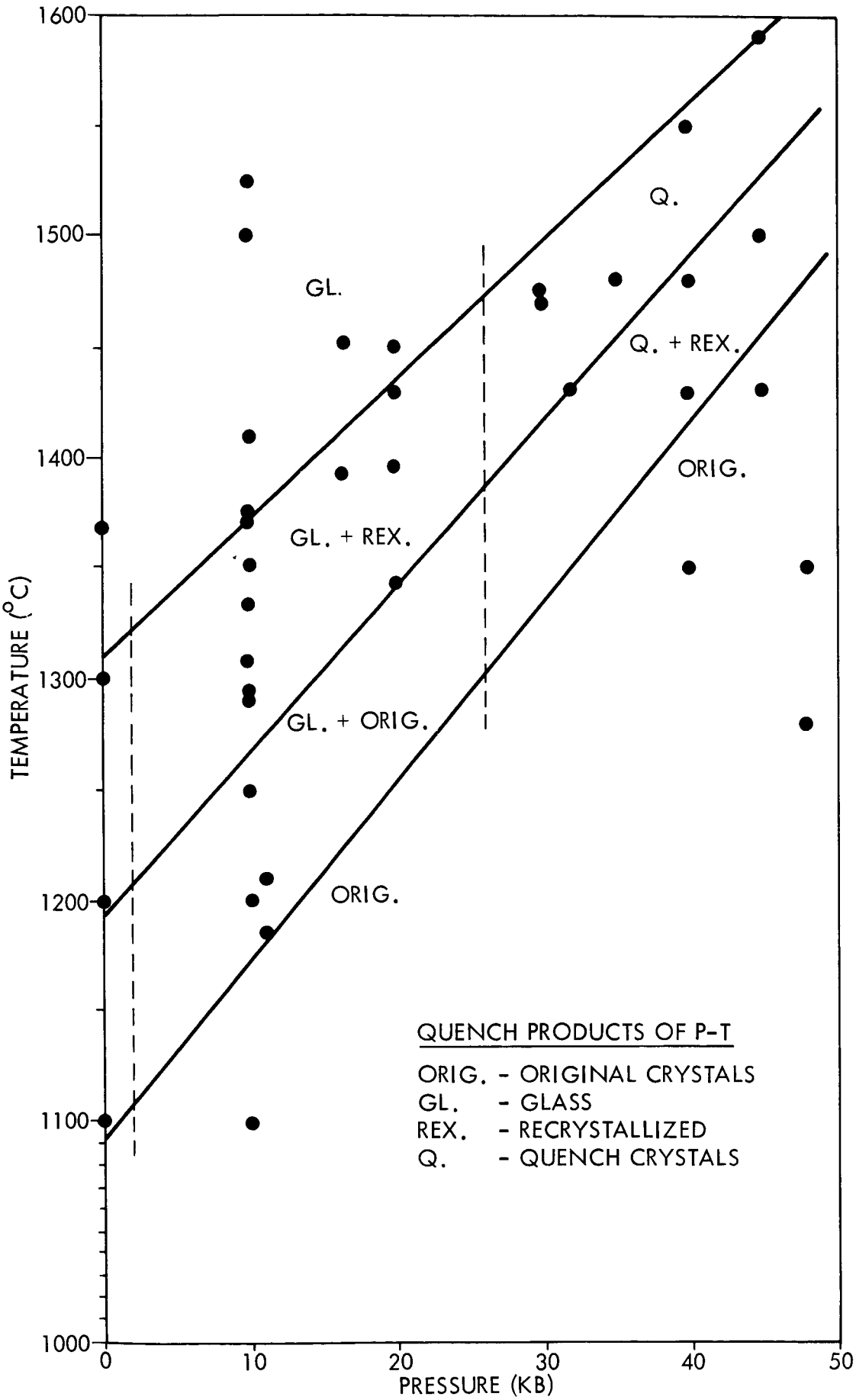
PLANNED ACTIVITY FOR NEXT QUARTER

We will make petrographic determinations of cast and formed rock shapes and postulate possible utilities.

E. Azmon

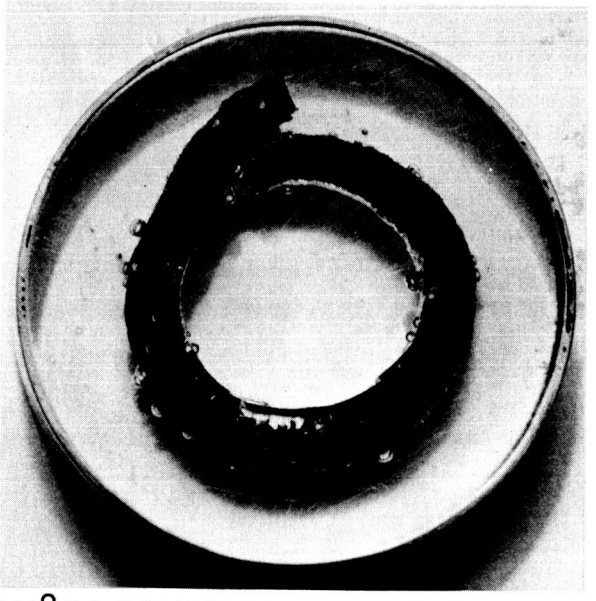
E. Azmon, Ph.D.
Principal Investigator

J. W. Moyer, Director
Physical Sciences

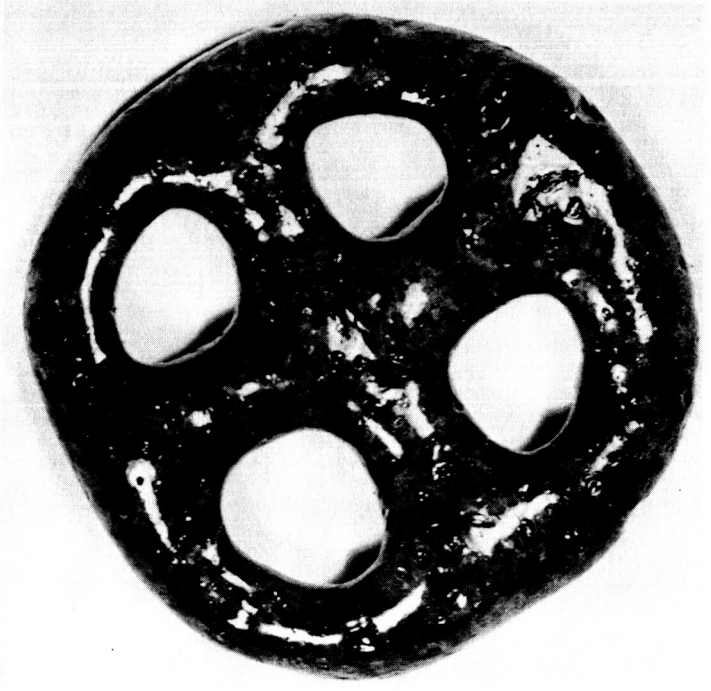


GENESIS DIAGRAM FOR GABBRO: PRESSURE VS TEMPERATURE

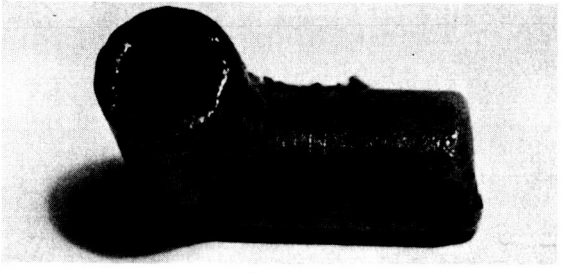
Figure 1



(a) BASALT 1080°C 1 1/2 HOURS BENDING BELOW THE MELTING



(b) OBSÈDIAN DUST 1300°C 1 1/2 HOURS CAST



(c) OBSÈDIAN DUST 1075°C 12 HOURS MELT AND CAST

Figure 2